Utah.—Unusually warm weather prevailed from the 8th to 13th and from the 21st to 24th. Light frost occurred in elevated regions of the State on the 2d and 3d, and of the northern counties on the 18th. Potato vines and tender plants were nipped, but no serious damage done. With the exception of the north-central part of the State, the rainfall was too light to be beneficial. Dry land wheat was badly damaged by drought, and over the greater portion of the State will be a failure, or nearly so. The ranges are in poor condition. Irrigated crops did well.—*L. H. Murdoch.*

Virginia.—The month was not favorable for crop growth. Beginning with the 1st and continuing with but few interruptions until the last decade the weather was cool and entirely too dry for crops to make seasonable advance. Light frosts occurred on various dates, both early in the month and again between the 21st and 23d doing some slight damage.—*Edward A. Evans.*

Washington.—The month was cool and dry, not favorable for the best growth of crops. Frost on the 5th was heavy in some localities of the eastern section and injured tender vegetables. During the third week of the month hot weather and drying winds caused some injury to wheat, particularly spring sown wheat, on light soils and clay patches. Potatoes were slightly set back by the dry spell.—*G. N. Salisbury.*

West Virginia.—June was an unusually cool month. Frosts were recorded in high altitudes on the 9th and 24th. The low temperatures had rather an injurious effect in retarding the growth of corn, but the condition of all other crops was generally improved. Heavy showers during the fourth week were generally unfavorable for harvesting. At the close of the month wheat and clover harvesting were in progress with about half yields; oats were heading, and a fair crop was expected; meadows were improving, but a light crop was anticipated; potatoes and garden truck were growing nicely; apples and peaches fell considerably during the month, and the prospect was for half a crop.—*E. C. Vose.*

Wisconsin.—Weather conditions were mainly favorable for crops. Frequent showers prevented proper cultivation of corn, but other crops made remarkably rapid growth. Pastures exceptionally good and stock excellent. Apples deteriorated, but small fruits generally satisfactory.—*J. W. Schaeffer.*

Wyoming.—Continued dry weather till the 28th of the month caused ranges to dry and burn in many sections of the State, but good rains after the 28th revived the growth of the grass, and gave good prospect for fall and winter feed, as well as increasing the prospect for a hay crop. Irrigated crops made favorable growth, and first crop alfalfa was usually up to, and in some sections exceeded, the average. Frosts did some damage to tender vegetation.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

HANN'S METEOROLOGY.[1]

By Prof. FRANK H. BIGELOW.

This great work by the well known Austrian meteorologist, Dr. Hann, whose name is a guarantee for its high scientific value, is handsomely printed on large quarto pages in three kinds of type; the first covering the main course of the thought, the second many important scientific comments and references, the third an exceedingly rich bibliography of meteorology and some mathematical developments. It is well executed throughout, is very free from typographical errors, contains many fine plates of phenomena, numerous drawings, a complete index and table of contents. The book is intended to describe the state of meteorology at the end of the nineteenth century, and this large task could hardly have been performed by any one in a more satisfactory manner. The amount of labor required to digest the mass of literature which has been produced in the past thirty or forty years, since the appearance of Dr. E. E. Schmid's Lehrbuch of 1860, will be realized with difficulty by a non-professional reader, but it is a surprise to see how little has escaped Dr. Hann's attention, judging at least by his generous and frequent references to the work of American meteorologists, and especially of the United States Weather Bureau. It has evidently been his intention to bring forward all the important facts that may be regarded as in anywise beyond the range of speculation and controversy, and each department of meteorology is very fully exploited. At the same time every reader will be impressed with the conservative and judicial tone of the writing, so that it may be said that a safe book has been put into the hands of students who are engaged in this field of science. It will be gratifying to the meteorologists of the Weather Bureau to find the views they have advocated during the past ten years almost without exception in accord with the conclusions adopted by Dr. Hann. This makes us feel that meteorology is at last taking root in firm ground, and that its healthy growth is now assured.

The first impression regarding this work is that the book is a very large one to read, and yet, even its present size is obtained only by omitting entirely to treat such important topics as methods of forecasting, weather periods, numerous mathematical papers of physicists discussing the more purely dynamic problems, and the development of the equations of motion together with their application to the problems of atmospheric circulation. Moreover, as one reads, there is nothing superfluous even for a professional student, and any omission would be a distinct loss to the subject; especially would one be sorry to have had the bibliography reduced to any extent. The treatment is rich in two special lines: (1) in the periodic variations of all the atmospheric elements, and (2) in the physics of static meteorology as distinct from dynamic meteorology. Such important mathematical problems as development in series, the thermodynamic relations in vertical and horizontal directions, and the barometry of the atmosphere, are suitably discussed with much clearness in the appendix, so that every student will find himself much assisted by reading Hann's treatment of these topics.

There are a number of theories, regarding the scientific truth of which doubt has existed, and it may therefore be proper to state briefly Dr. Hann's adopted views regarding them, without any discussion, since the opinions of such a master of meteorology deserve to carry much weight with them. I shall pass over many items of interest for the sake of briefly mentioning subjects of the character just indicated. The permanent gas constituents of the air, oxygen, nitrogen, carbonic dioxide, argon, helion, krypton, metargon and neon, are mixed according to Dalton's law in the lower strata, but in the same percentages in the highest strata explored, this being caused by the circulation of the atmosphere. The nuclei of condensation of aqueous vapor are ions as well as particles of dust; but the vapor is distributed by a law different from Dalton's. The solar constant may be taken as 3 gram calories, though possibly it should be advanced toward 4, but not beyond. The minimum temperature of the sun is not far from 7,000° C. The natural period of solar insolation has one maximum about 1 or 2 p. m., and one minimum about 4 or 5 a. m., but this is often converted into a double period by disturbances caused by vertical convection during the afternoon, the double period appearing in the diurnal pressure, electric potential, and vapor tension of the atmosphere. Stefan's law of the intensity of radiation $J_0 = 0.723 \times 10^{-10}\ T^4$, where T is the absolute temperature, is applicable throughout space, except as modified by the solar or planetary atmospheres. All short series of observations should be carefully reduced to the corresponding long series by suitable corrections. There is no evidence that climates have changed since the beginning of accurate observations. The old series of balloon observations by Glaisher is not comparable with those derived from modern instruments. The boiling point of water method is not available for the accurate determination of altitudes and variations of gravity, on account of the narrow range of temperature

[1] Lehrbuch der Meteorologie, von Dr. Julius Hann, Professor an der Universität zu Wien, mit 111 Abbildungen im Text, 8 Tafeln in Lichtdruck und Autotypie, sowie 15 Karten. Vorwort und Zeichniss XIV pp. Text 805 pp. 4to. Leipzig, 1901. Chr. Herm. Tauchnitz.

available for the exact observation. The secular variations of pressure are accompanied by a flow of air from one hemisphere to the other and back again. The diurnal variation of the barometer still remains a difficult problem, but there is some evidence of its being a wave swinging through the air in forced vibrations, such as Lord Kelvin suggested. Hutton's theory of condensation of vapors mixed at different temperatures is applicable to the formation of clouds but not to rainfall. A reliable self-registering psychrometer is greatly needed in practical meteorology. The measures of rainfall ought to be reduced to a scientific scale in all cases.

The Espy–Köppen theory of the diurnal variation of the wind velocity in different strata is satisfactory. The relative amount of solar radiation absorbed in the upper and the lower atmosphere is an important problem only partially worked out. The deflecting and centrifugal forces expend no energy on the movement of masses of air, but change only the direction of their motion and not the velocity. The vertical thickness of the land and sea breezes, the mountain and valley breezes, and the monsoon and trade winds ought to be carefully determined in different localities. Some doubt is expressed regarding the completeness of the canal theory of the general circulation of the atmosphere between the equator and the poles, but the scheme of Ferrel is approved in general. The vertical convectional theory of the origin of cyclones is vigorously rejected and the horizontal convection theory is favored. The action of countercurrents of air is distinctly illustrated in the formation of tornadoes and waterspouts, tropical hurricanes and extratropical cyclones; the origin and direction of two independent component streams of air are plainly described. The general equation of equilibrium in terms of gradient, deflecting and centrifugal forces is clearly deduced and its meaning carefully illustrated. A good historical description is given of the first weather charts and the earliest synoptic daily maps. The deflection angle seems to be preferred to the inclination angle for the purpose of analyzing the relation of the wind direction to the gradient. It is shown that V-shaped depressions are characteristic of the Southern Hemisphere, with counter winds on each side, while cyclonic gyrations are but further developments of the same phenomenon, and are more commonly found in the Northern Hemisphere. Summer hot waves are explained as stagnant masses of air, in which heat gradually accumulates at the ground and then increases upward to great heights. The foehn wind effect is due to dynamic heating of the air descending from the crest of a mountain range to the valley. The bora is due to masses of air of different temperatures lying close together without mixing, and then pushing forward as a whole, as over a coast line. The types of American weather have not been sufficiently developed and published. A strong and even abnormal vertical temperature gradient accompanies the formation of thunderstorms, which are attended by an inversion of the overlying strata. The squall in thunderstorms is a horizontal roll at the front. The formation of hail seems to be due to a tornado tube or vertical whirl in the upper strata of the cloud, and Ferrel's orbit theory for the formation of the successive layers of ice and snow in the hailstone is regarded with favor. The secular variation of nearly all the meteorological elements in the 11-year and the 35-year solar periods is admitted, but these researches are not yet in a conclusive or satisfactory state of development. The stratification of the atmosphere with currents of different temperatures, especially where abnormally cold air overlays excessively warm strata, and the consequences of such unstable conditions of equilibrium are well depicted. The theory of the cause of the atmospheric electric potential fall that seems most promising is the ionization theory of gases which is briefly described.

Finally, I shall venture to remark that it is likely that further consideration, and the accumulation of suitable observations, will probably tend to modify Dr. Hann's views regarding the canal theory of the general circulation, and especially as regards Ferrel's idea of the westward flow at the north pole, and the triple stratification of currents on the polar side of the trade wind zones; the cause of the double diurnal barometric wave is still open to discussion; also there are very serious objections against accepting Ferrel's theory of the orbital motion of hailstones in the neighborhood of a tornado tube in the upper strata of a thunderstorm cloud. On pages 272, 273, 275 it is stated that in the Weather Bureau observations of 1896–97 certain cloud heights were measured by nephoscopes. The fact is that all the cloud heights were determined by the theodolite, and then certain mean heights were adopted to carry forward the discussion of the nephoscope observations.

Dr. Hann deserves the thanks and will receive the congratulations of all meteorologists for his able, useful, and satisfactory work. It is a book that should be translated into English and placed in the libraries of all colleges, in library reference rooms, and in the hands of those students who intend to take up the subject seriously. It will give a strong impetus to sound learning in this branch of science, and it is a worthy companion to Dr. Hann's well known "Klimatologie."

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

Meteorologische Zeitschrift. Wien. Band 19.

Paulsen, A. Vorläufige Mittheilungen über einige Arbeiten der Dänischen Expedition in Utsjoki. Pp. 276–279.

Ekholm, Nils. Ueber die Höhe der homogenen Atmosphäre und die Masse der Atmosphäre. Pp. 249–260.

—— Täglicher Gang des Luftdruckes und der Temperatur zu San José de Costa Rica. Pp. 273–274.

Krebs, W. Neue Sonnenringbeobachtung. P. 275.

—— Klima von Potsdam. Pp. 275–276.

Exner, Felix M. Ueber den Gleichgewichtszustand eines schweren Gases. Pp. 278–279.

—— Das Weather Bureau. P. 279.

—— Physiologische Wirkung des verdünnten Luftdrucks. Pp. 279–280.

—— Verdunstung zu Camden Square, London. P. 281.

—— Grosser Regenfall in England am 12 Juli 1900. Pp. 280–281.

—— Zur Meteorologischen Optik. P. 282.

Benndorf, H. Ueber ein Mechanisch registrirendes Elektrometer für luftelektrische Messungen. Pp. 282–283.

Birkeland, Kr. Norwegische Erdmagnetische Expedition 1902–1903. Pp. 283–284.

—— Das Darmer'sche Quecksilberbarometer. Pp. 284–285.

—— Klima von Pemba, Ostafrika. P. 285.

—— Galvanometrische Beobachtung ferner Gewitter. Pp. 285–286.

—— Meteorologische Beobachtungen im (sog.) arktischen Nordamerika. P. 286.

—— Gewitter und Mondphasen. P. 289.

Schwarz, L. St. Elmsfeuer auf der Schneekoppe. Pp. 289–290.

Weitlaner, Franz. Einzelne Sonnenuntergangs-und Dämmerungsformen in subtropischen und tropischen Gebieten. Pp. 290–292.

—— Deutsche Meteorologische Gesellschaft. Jahresbericht und Rechnungsablage für 1901. Pp. 270–271.

Hann, Julius. W. v. Bezold: Ueber klimatologische Mittelwerthe für ganze Breitekreise. Pp. 260–263.

Hann, Julius Teisserenc de Bort über die Temperaturabnahme mit der Höhe. Pp. 272–273.

Hann, Julius. Anschliessende Bemerkungen über die Mittelwerthe der meteorologischen Elemente für die Ganze Erdoberfläche. Pp. 263–269.

Hann, Julius. Die Temperatur des Mai in Wien. Pp. 271–272.

Hann, Julius. Interdiurne Temperaturveränderlichkeit in Mexiko. P. 281.